Chapter 9
Cross-Media Interpretations

9.1 Summary of PCB and *trans*-Nonachlor Concentrations in Lake Michigan Compartments

PCB and *trans*-nonachlor levels were measured in Lake Michigan air, water, sediment, tributaries, plankton, and fish. PCBs and *trans*-nonachlor were found throughout the Lake Michigan ecosystem. PCBs were detected above sample-specific detection limits in all samples collected from all ecosystem compartments except for tributaries (Table 9-1). Two percent of dissolved tributary samples and nine percent of particulate tributary samples did not contain detectable levels of PCBs (i.e., not even one PCB congener above its sample-specific detection limit). Within the various ecosystem compartments, an average of 30 to 92 different PCB congeners were detected above sample-specific detection limits (Table 9-1). *trans*-Nonachlor was less frequently detected than PCBs. Detection frequency of *trans*-nonachlor in environmental samples ranged from 29% in dry deposition to 100% in plankton and fish.

Table 9-1. Summary of Samples from each Ecosystem Compartment with Detectable Levels of PCBs and *trans*-Nonachlor

Ecosystem Compartment	Fraction	PCBs		*trans*-Nonachlor
		% Samples with PCBs Detected above SSDL[a]	Average Number of PCB Congeners Detected above SSDL[a]	% Samples with *trans*-Nonachlor Detected above SSDL[a]
Atmosphere	Vapor	100	59	65
	Particulate	100	35	20
	Precipitation	100	84	90
	Dry Deposition	100	30	29
Tributary	Dissolved	98	36	34
	Particulate	91	47	59
Open Lake	Dissolved	100	40	79
	Particulate	100	59	88
Sediment	–	100	74	72
Plankton	–	100	92	100
Fish	–	100	68	100

[a] Sample-specific detection limit

Figure 9-1 shows the distribution of PCBs throughout the atmosphere, tributaries, water column, and sediments of Lake Michigan. Vapor-phase total PCB concentrations averaged from 21 to 2600 pg/m^3 at shoreline and over-water sampling stations. Higher atmospheric total PCB concentrations were generally found above the southern Lake Michigan basin and southern shoreline, with the highest atmospheric concentration observed at the IIT Chicago site (Figure 9-1). Lower atmospheric concentrations were generally observed above the central and northern regions of the lake, however, some northern stations such as Beaver Island maintained higher concentrations. Particulate-phase total PCB concentrations were much lower than vapor-phase concentrations, averaging from 0.37 to 91 pg/m^3 at shoreline and over-water sampling stations. At individual stations, average particulate-phase total PCB concentrations were only 0.03% to 8.2% of vapor-phase concentrations. In precipitation, total PCB concentrations averaged from 360 to 16000 pg/L at shoreline and over-water sampling stations, with the highest average precipitation concentration at the IIT Chicago site. Average total PCB concentrations in precipitation at all of the stations were greater than the average dissolved total PCB concentration in Lake Michigan, and average precipitation concentrations at the IIT Chicago site were higher than dissolved total PCB concentrations in all of the tributaries except for the Grand Calumet and Sheboygan Rivers.

In Lake Michigan tributaries, total PCB concentrations averaged from 0.43 to 35 ng/L in the dissolved phase and from 0.25 to 55 ng/L in the particulate phase. Total PCB concentrations were highest in the more urban and industrialized watersheds (Fox, Sheboygan, Milwaukee, Grand Calumet, and Kalamazoo Rivers). In these tributaries, total PCB concentrations in the dissolved and particulate phases averaged more than 23 ng/L. The remaining tributaries, which are comprised of more agricultural and forested watersheds (Grand, Manistique, Menominee, Muskegon, Pere Marquette, and St. Joseph Rivers), all contained less than 2.9 ng/L of total PCBs.

Within the Lake Michigan water column, total PCB concentrations averaged 0.18 ng/L in the dissolved phase and 0.073 ng/L in the particulate phase. Dissolved total PCB concentrations were highest at the southern end of Green Bay (Figure 9-1), presumably due to the significant PCB load from the Fox River in combination with the reduced dilution available in Green Bay and limited mixing between Green Bay and Lake Michigan. Total PCB concentrations in the dissolved phase averaged as high as 0.653 ng/L at the lower end of Green Bay (Station GB17). Within Lake Michigan proper, total PCB concentrations in the dissolved phase averaged from 0.104 to 0.373 ng/L at the various sampling stations. Contour plots of dissolved phase total PCB concentrations indicate a general trend of higher concentrations in the southern Lake Michigan basin than in the northern basin. This observation is consistent with atmospheric concentrations over the lake, which also tend to be higher over the southern basin, particularly near Chicago (Figure 9-1).

Total PCB concentrations in surficial sediments of Lake Michigan ranged from 0.138 to 219 ng/g. Contour plots indicate that total PCBs are accumulating in the depositional and transitional regions of Lake Michigan (Figure 9-1). In particular, PCBs accumulate at relatively high concentrations (> 100 ng/g) along the eastern side of the southern basin, as well as at a few of the deeper stations in the southern and central basins. Among the lake's depositional and transitional zones, sediment PCB concentrations generally increase from north to south. Total PCB concentrations averaged 69.7 ng/g in the southern basin, 50.5 ng/g in the central basin, 41.6 ng/g in the northern basin, and 7.27 ng/g in the straits region. Only in the southern and central basins did total PCBs exceed 100 ng/g, and only in the southern basin did total PCBs exceed 150 ng/g. Increased PCB concentrations in the sediments of the southern basin are consistent with the increased atmospheric PCB concentrations above the southern basin and the larger number of urban and industrial sources surrounding the southern portions of the lake.

Figure 9-2 shows the distribution of *trans*-nonachlor throughout the atmosphere, tributaries, water column, and sediments of Lake Michigan. Vapor-phase *trans*-nonachlor concentrations averaged from 0 to 29 pg/m^3 at shoreline and over-water sampling stations. Like total PCB concentrations, higher atmospheric *trans*-nonachlor concentrations were generally found above the southern Lake Michigan basin and southern shoreline, with the highest atmospheric concentration observed at the IIT Chicago site (Figure 9-2).

Figure 9-1. Concentrations of Total PCBs in the Atmosphere, Tributaries, Water Column, and Sediments of Lake Michigan

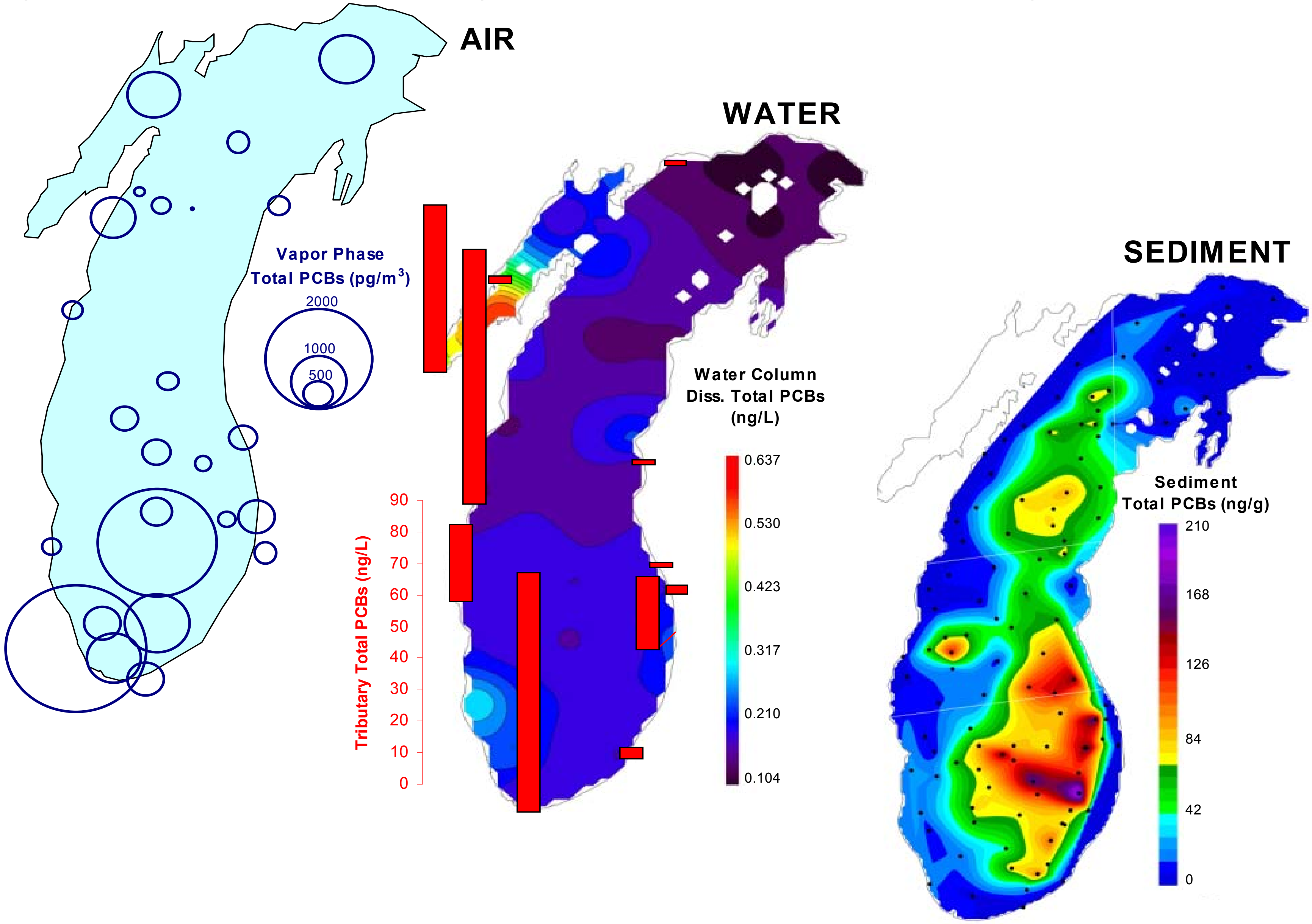
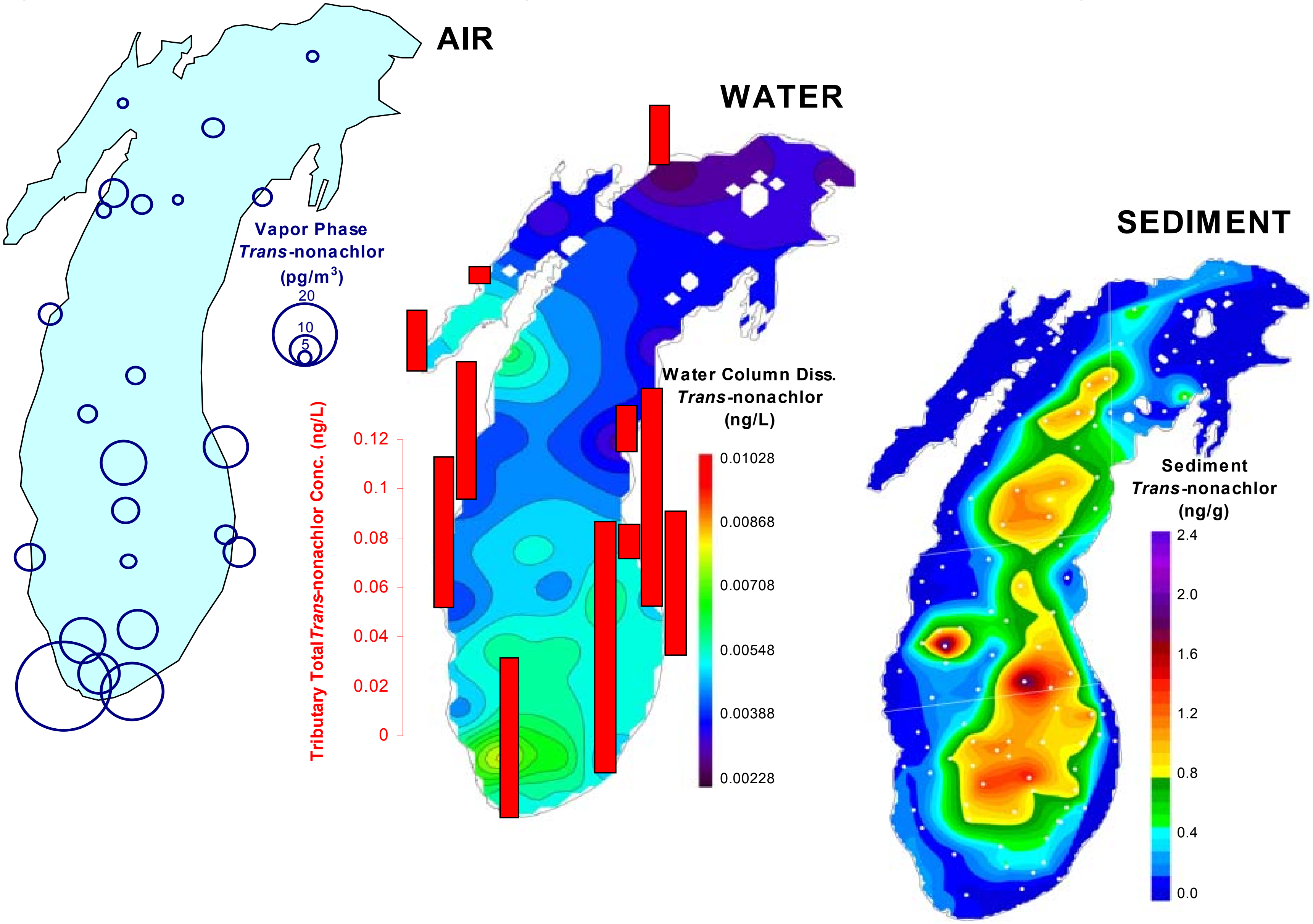


Figure 9-2. Concentrations of *trans*-Nonachlor in the Atmosphere, Tributaries, Water Column, and Sediments of Lake Michigan



Particulate-phase *trans*-nonachlor concentrations were much lower than vapor-phase concentrations, averaging from 0.16 to 1.8 pg/m^3 at shoreline and over-water sampling stations. At individual stations, average particulate-phase *trans*-nonachlor concentrations were only 2.6% to 14% of vapor-phase concentrations. In precipitation, *trans*-nonachlor concentrations averaged from 0.0 to 100 pg/L at shoreline and over-water sampling stations, with the highest average precipitation concentration at the IIT Chicago site. Average *trans*-nonachlor concentrations in precipitation at all except three of the stations were greater than the average dissolved *trans*-nonachlor concentration in Lake Michigan, and average precipitation concentrations at the IIT Chicago site were higher than dissolved *trans*-nonachlor concentrations in all of the tributaries.

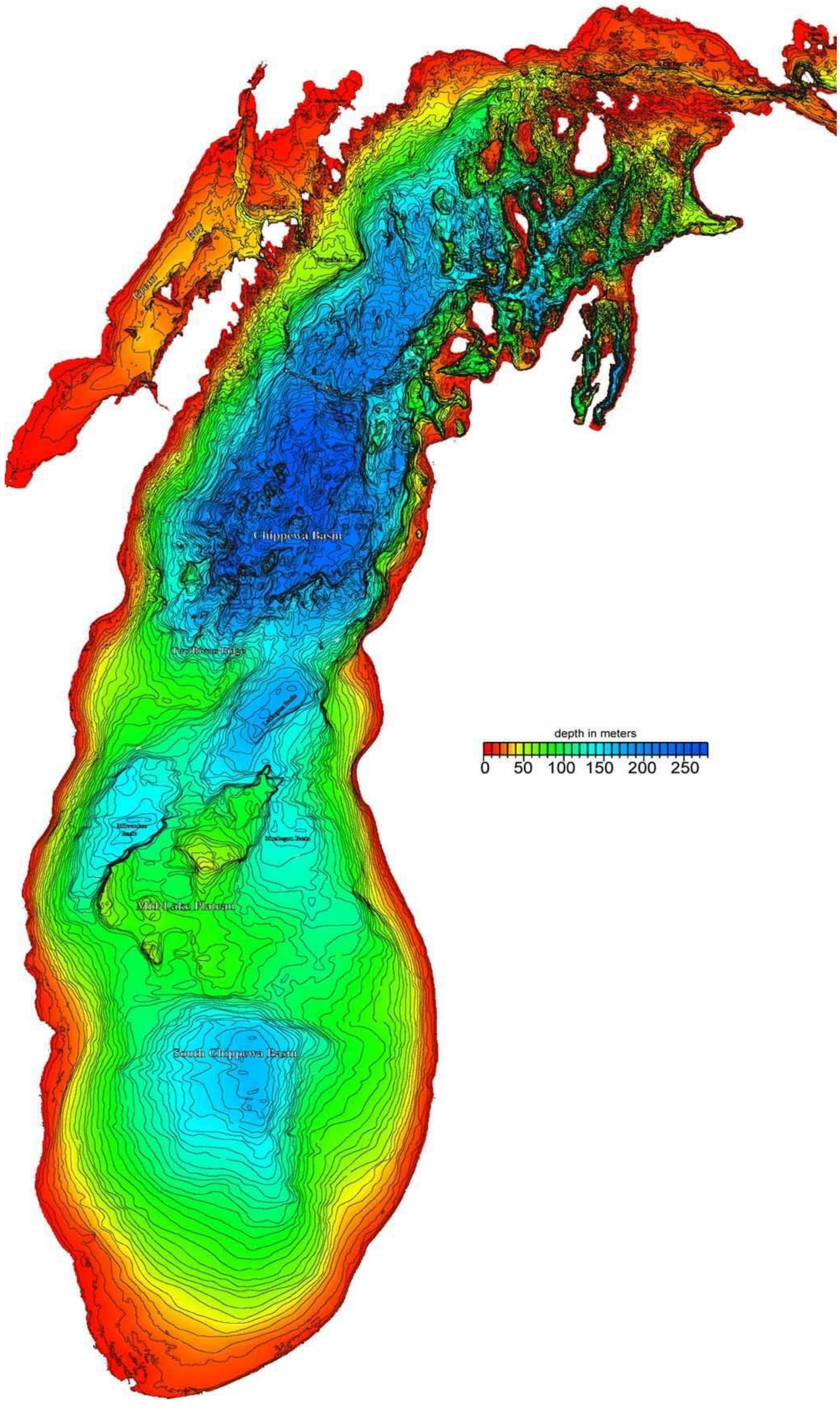
In Lake Michigan tributaries, *trans*-nonachlor concentrations averaged from 0.0033 to 0.026 ng/L in the dissolved phase and from 0.0028 to 0.074 ng/L in the particulate phase. Unlike PCBs, which were highest in urban and industrial influenced watersheds, *trans*-nonachlor concentrations were highest in the heavily agricultural watersheds of the St. Joseph and Grand Rivers. Mid-range *trans*-nonachlor concentrations were observed in the urban and industrial influenced watersheds of the Fox, Sheboygan, Milwaukee, Grand Calumet, and Kalamazoo Rivers; and the lowest *trans*-nonachlor concentrations were observed in the more forested watersheds of the Menominee, Manistique, Muskegon, and Pere Marquette Rivers.

Within the Lake Michigan water column, *trans*-nonachlor concentrations averaged 0.0058 ng/L in the dissolved fraction and 0.0021 ng/L in the particulate fraction. Among open-water sampling stations, dissolved *trans*-nonachlor concentrations averaged from 0.00228 to 0.0236 ng/L, with the highest concentration at Station 17 in the southern Lake Michigan basin (Figure 9-2). Contour plots of dissolved-phase *trans*-nonachlor concentrations indicate a general trend of higher concentrations in the southern Lake Michigan basin with isolated areas of high concentration in the northern basin. This observation is consistent with atmospheric concentrations over the lake, which also tend to be higher over the southern basin, particularly near Chicago (Figure 9-2). The apparent relationship between atmospheric and open-lake concentrations may suggest atmospheric deposition drives open-water concentrations, or it may suggest that *trans*-nonachlor may cycle between lake water and the atmosphere in manner similar to that proposed by Mackay and Patterson (1986) for PCBs (see Section 2.1.4).

trans-Nonachlor concentrations in surficial sediments of Lake Michigan ranged from 0.00250 to 2.830 ng/g. Contour plots indicate that *trans*-nonachlor is accumulating in the depositional and transitional regions of Lake Michigan (Figure 9-2). Unlike PCBs, *trans*-nonachlor does not exhibit elevated concentrations in the southern basin relative to the central and northern basins. *trans*-Nonachlor concentrations averaged 0.599 ng/g in the southern basin, 0.638 ng/g in the central basin, and 0.560 ng/g in the northern basin. Also unlike PCBs, *trans*-nonachlor is not preferentially accumulating along the eastern side of the southern basin. *trans*-Nonachlor is preferentially accumulated in the deeper regions of the lake just to the east and west of the mid-lake reef identified as the Port Washington biota box in this study (Figures 9-2 and 9-3).

Within living components of the Lake Michigan ecosystem, PCBs and *trans*-nonachlor were accumulated at concentrations higher than in any abiotic ecosystem component. PCBs and *trans*-nonachlor exhibited classical biomagnification, with concentrations increasing with increasing trophic level in the Lake Michigan food web (see Section 9.2). Accumulation of PCBs in top predator fish has reached levels of concern for human health and spawned fish consumption advisories throughout Lake Michigan and many Lake Michigan tributaries.

Figure 9-3. Lake Michigan Bathymetry

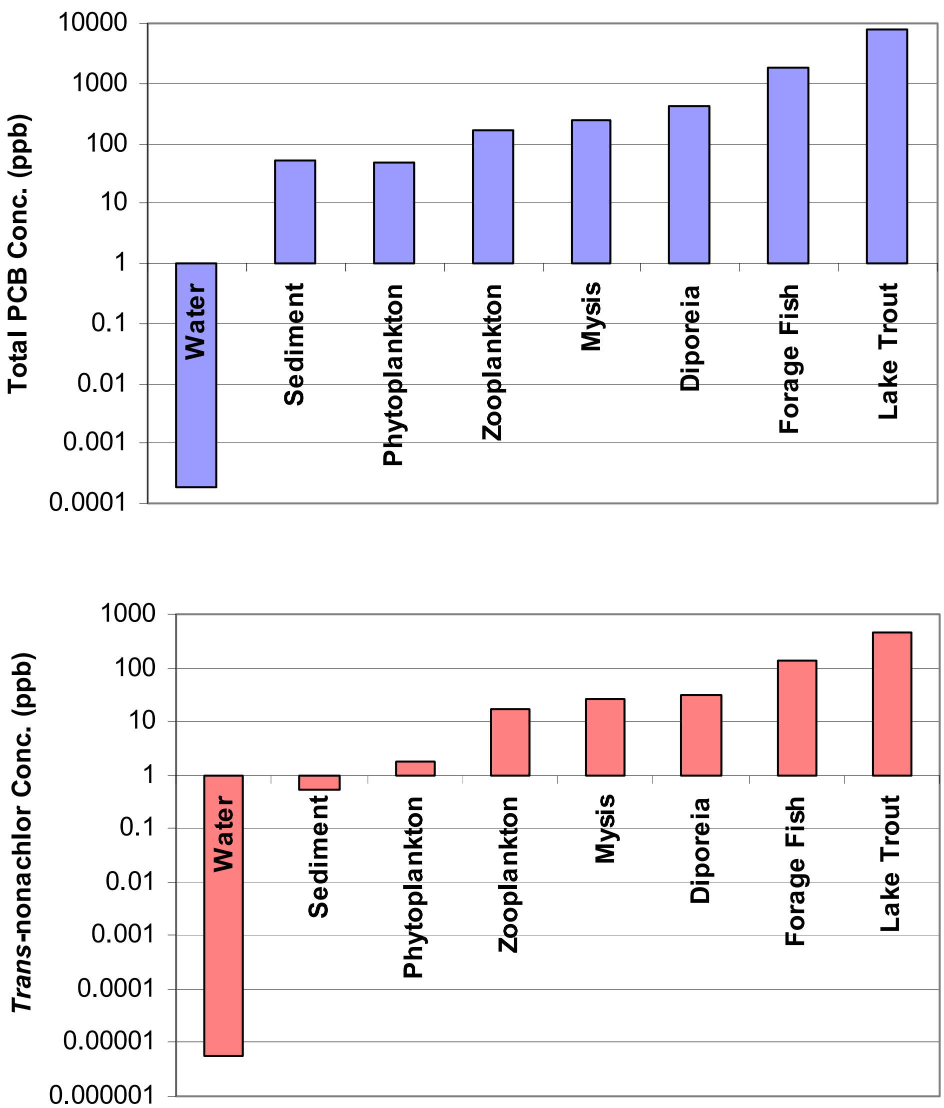


9.2 Bioaccumulation and Biomagnification

In the LMMB Study, classical bioaccumulation and biomagnification of PCBs and *trans*-nonachlor were observed. These hydrophobic and lipophilic contaminants were bioaccumulated in living tissue at levels well above water column or even sediment concentrations. Bioaccumulation factors for total PCBs ranged from 2.7×10^5 to 4.3×10^7, and bioaccumulation factors for *trans*-nonachlor ranged from 3.0×10^5 to 8.3×10^7.

Not only were PCBs and *trans*-nonachlor bioaccumulated in living tissue above water concentrations, but these contaminants were biomagnified within the Lake Michigan food web. PCB and *trans*-nonachlor concentrations increased with each successive trophic levels (Figure 9-4).

Figure 9-4. Total PCB and *trans*-Nonachlor Concentrations in Various Components of the Lake Michigan Ecosystem



Total PCB concentrations increased from 49 ng/g in phytoplankton to 170 ng/g in zooplankton, to 280 and 420 ng/g in *Mysis* and *Diporeia*, to 1900 ng/g in forage fish, to 7800 ng/g in the top predator, lake trout. *trans*-Nonachlor concentrations increased from 1.7 ng/g in phytoplankton, to 16 ng/g in zooplankton, to 25 and 32 ng/g in *Mysis* and *Diporeia*, to 140 ng/g in forage fish, to 480 ng/g in lake trout. From the bottom of the food web (phytoplankton) to the top of the food web (lake trout), total PCB concentrations increased by a factor of 160, and *trans*-nonachlor concentrations increased by a factor of 280.

Figure 9-5 shows the biomagnification factors between the various components of the Lake Michigan food web. The primary pelagic food web includes phytoplankton, zooplankton, forage fish, and lake trout. Biomagnification factors between each of these trophic levels varied from 3.4 to 11 for total PCBs and 3.4 to 9.5 for *trans*-nonachlor. For total PCBs, biomagnification was greatest from zooplankton to forage fish (11), with lower biomagnification from phytoplankton to zooplankton (3.4) and from forage fish to lake trout (4.2). For *trans*-nonachlor, biomagnification was high from phytoplankton to zooplankton (9.5) and from zooplankton to forage fish (8.6) and lower for forage fish to lake trout (3.4). Within this simplified pelagic food web, invertebrates such as *Mysis* may also play a role. *Mysis* may feed on herbivorous zooplankton, adding an additional trophic level to the pelagic food web, or they may be eaten directly by young top predators, effectively removing a trophic level.

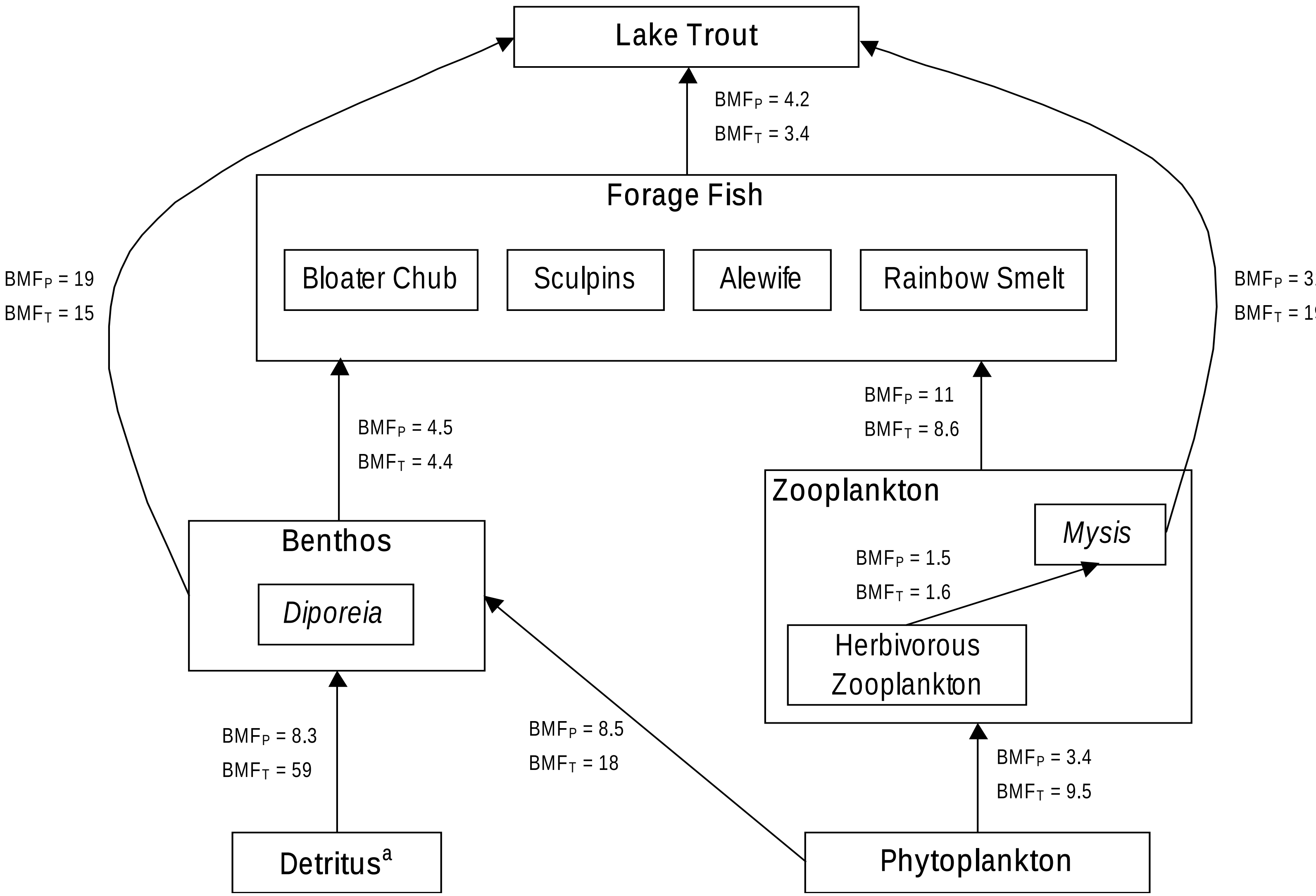
The simplified benthic food web consists of benthic invertebrates, such as *Diporeia*, that may feed on detritus or phytoplankton. The benthic invertebrates may then be preyed upon by bottom dwelling forage fish, which in turn may be preyed upon by lake trout. Within the benthic food web, biomagnification factors were greatest between phytoplankton and *Diporeia* (8.5 for PCBs and 18 for *trans*-nonachlor) and between detritus and *Diporeia* (8.3 for PCBs and 59 for *trans*-nonachlor). Biomagnification factors were lower between *Diporeia* and forage fish (4.5 for PCBs and 4.4 for *trans*-nonachlor) and between forage fish and lake trout (4.2 for PCBs and 3.4 for *trans*-nonachlor).

It should be noted that bioaccumulation and biomagnification factors for total PCBs calculated from this data are semi-quantitative. Total PCB concentrations were calculated from the sum of individual PCB congeners analyzed, and the number and the specific congeners analyzed differed among the sample matrices (water, plankton, and fish). This difference, however, should not affect conclusions concerning the biomagnification of PCBs in Lake Michigan, because water and lower trophic levels were analyzed for more PCB congeners than higher trophic levels. Total PCB concentrations in water, plankton, and fish represent 123, 126, and 93 individual or coeluting congeners analyzed for the respective matrices.

Similar to the PCB and *trans*-nonachlor biomagnification observed in the LMMB Study, Oliver and Niimi (1988) observed classical biomagnification of PCBs in the Lake Ontario food web. Oliver and Niimi (1988) observed increases in total PCB levels at each trophic level with an overall increase of 86 times from plankton to top predators. This is slightly lower than observed in Lake Michigan in the LMMB Study (factor of 160), however, Oliver and Niimi (1988) analyzed a mixture of phytoplankton and zooplankton to characterize the plankton compartment and analyzed a mixture of coho salmon, rainbow trout, and lake trout to characterize the top predator compartment. These approaches would tend to decrease the overall biomagnification measured by Oliver and Niimi (1988) in comparison to the LMMB Study data.

Koslowski *et al.* (1994) observed similar biomagnification of PCBs in the Lake Erie food web, and Kucklick and Baker (1998) observed similar biomagnification in Lake Superior. Both authors found increasing PCB concentrations with increasing trophic level. Through multiple linear regression and path analysis, Kucklick and Baker (1998) determined that the trophic level influenced PCB accumulation levels both directly and indirectly through its effect on lipid content.

Figure 9-5. Biomagnification Factors for Total PCBs (BMF_P) and *trans*-Nonachlor (BMF_T) in a Simplified Lake Michigan Food Web



[a]Concentrations of PCBs and *trans*-nonachlor in the sediment were used as a surrogate for detrital concentrations.

In the marine environment, authors have observed similar biomagnification of PCBs and other persistent organic pollutants. Hop *et al.* (2002) and Fisk *et al.* (2001) investigated biomagnification through marine food webs that have included water birds and mammals as top predators. In these studies, biomagnification at the upper end of these food webs (in the homeothermic mammal and avian populations) was even greater than at the lower end of the food web (in fish and invertebrates).

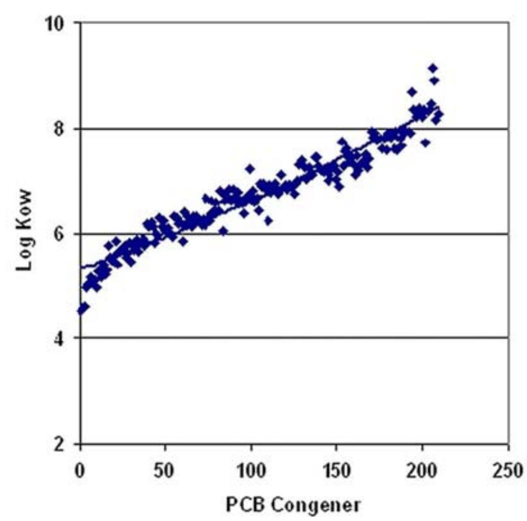
In contrast to the studies that have demonstrated biomagnification of PCBs in aquatic food webs, Berglund *et al.* (2000) concluded that total PCB concentrations did not steadily increase with increasing trophic level in 19 Swedish lakes. On a dry-weight basis, total PCB concentrations in fish were not significantly different from concentrations in zooplankton, however, Berglund *et al.* (2000) only investigated young-of-the-year fish and did not investigate piscivorous fish species. On a lipid-weight basis, total PCB concentrations in fish were significantly higher than in zooplankton, but were not significantly higher than in phytoplankton. As demonstrated in the LMMB Study, age (or length as a surrogate for age) certainly affects the bioaccumulation of PCBs. In attempting to factor out this effect by only using young-of-the-year fish, however, a true comparison of trophic levels cannot be adequately made. Increases in the lifespan of organisms are a component of increasing trophic level.

9.3 Fractionation

While the discussion of bioaccumulation and biomagnification has focused primarily on total PCBs, each of the 209 PCB congeners have differing physical and chemical properties and may be accumulated and biomagnified differentially. In general, more-chlorinated PCB congeners are more hydrophobic and more lipophilic. This chemical trend can be described by the octanol-water partition coefficient (K_{OW}), which is the ratio of the concentration of a substance preferentially dissolved in an octanol phase to the concentration of that substance dissolved in the water phase. More-chlorinated PCB congeners have higher octanol-water partition coefficients (Figure 9-6).

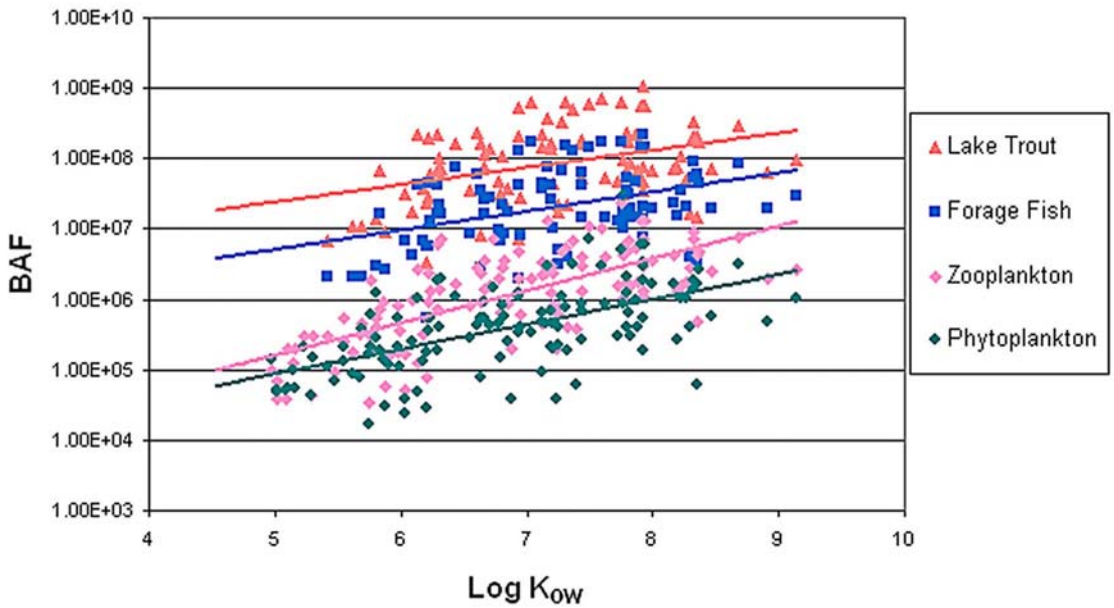
Because more-chlorinated PCB congeners are more hydrophobic and more lipophilic, these more-chlorinated congeners more readily bioaccumulate in living tissue. Figure 9-7 shows the bioaccumulation factors for each of the trophic levels versus K_{OW}. The slope for each of the trophic levels is positive, indicating that the more-chlorinated PCB congeners with higher K_{OW} values are bioaccumulated to a greater degree. Slopes for these log-log regressions range from 0.24 to 0.46. These regressions also indicate increased bioaccumulation at each trophic level. For a given K_{OW}, PCBs are increasingly more accumulated in phytoplankton, zooplankton, forage fish, and lake trout.

Figure 9-6. Octanol-water Partition Coefficients (K_{OW}) for PCB Congeners



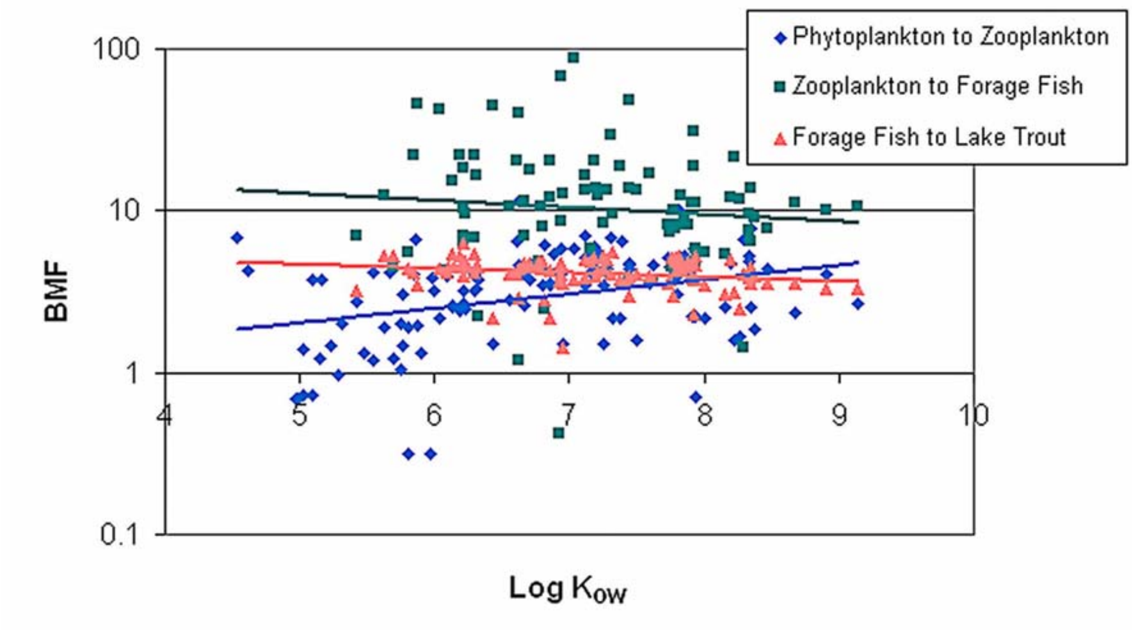
Many other authors have documented this same trend of increasing PCB bioaccumulation with increasing K_{OW} or increasing chlorination. Oliver and Niimi (1988) observed that less-chlorinated PCB congeners comprised a higher fraction of total PCBs in water than in higher trophic levels in Lake Ontario. Koslowski *et al.* (1994) also observed increased bioaccumulation with increased PCB congener chlorination in the Lake Erie food web. Willman *et al.* (1997) similarly found that penta-, hexa-, and heptachloro congeners were enriched relative to other congeners as PCBs moved to higher trophic levels from sediments to plankton to fish.

Figure 9-7. Bioaccumulation Factors in the Lake Michigan Food Web versus Log Octanol-Water Partition Coefficients for Individual PCB Congeners



In the lower pelagic food web, it was observed that more-chlorinated PCB congeners not only preferentially accumulated from water, but these more-chlorinated congeners also preferentially accumulated in the transfer from prey to predator. For example, the slope of the log BAF versus log K_{OW} curve increases from phytoplankton to zooplankton. This indicates that relative to phytoplankton, zooplankton preferentially accumulated more-chlorinated PCB congeners. This was not true of each trophic transfer, however. The slopes of the curves did not increase with each increasing trophic level. Figure 9-8 shows biomagnification factors plotted against log K_{OW} values of the PCB congeners. Only in the transfer from phytoplankton to zooplankton were more-chlorinated PCB congeners preferentially accumulated. The slopes for zooplankton to forage fish and for forage fish to lake trout were negative and close to zero. Kucklick and Baker (1998) also did not observe fractionation of PCB congeners between predator and prey. More chlorinated PCB congeners with higher K_{OW} values were not selectively accumulated in predators.

Figure 9-8. Biomagnification Factors in the Lake Michigan Food Web versus Log Octanol-Water Partition Coefficients for Individual PCB Congeners



9.4 Toxic PCB Congeners

It is important to independently consider the concentration and accumulation of individual PCB congeners, because the individual congeners bioaccumulate differentially and have varying degrees of toxicity. The World Health Organization has identified the PCB congeners listed in Table 9-2 as toxic and "dioxin-like" based on structure-activity relationships (Van den Berg *et al.*, 1998). For each of these toxic PCB congeners, the World Health Organization also has assigned toxicity equivalency factors (TEFs), which relate the toxicity of each congener to the toxicity of 2,3,7,8-tetra-chlorodibenzo-*p*-dioxin (TCDD). A compound with a TEF value of 1.0 is as potent as TCDD, and a compound with a TEF value of 0.01 is estimated to be 100 times less potent than TCDD. Based on the assumption of additivity, the product of individual PCB concentrations and TEFs can be summed to calculate the toxic equivalent concentration (TEQ) of all dioxin-like compounds in terms of TCDD.

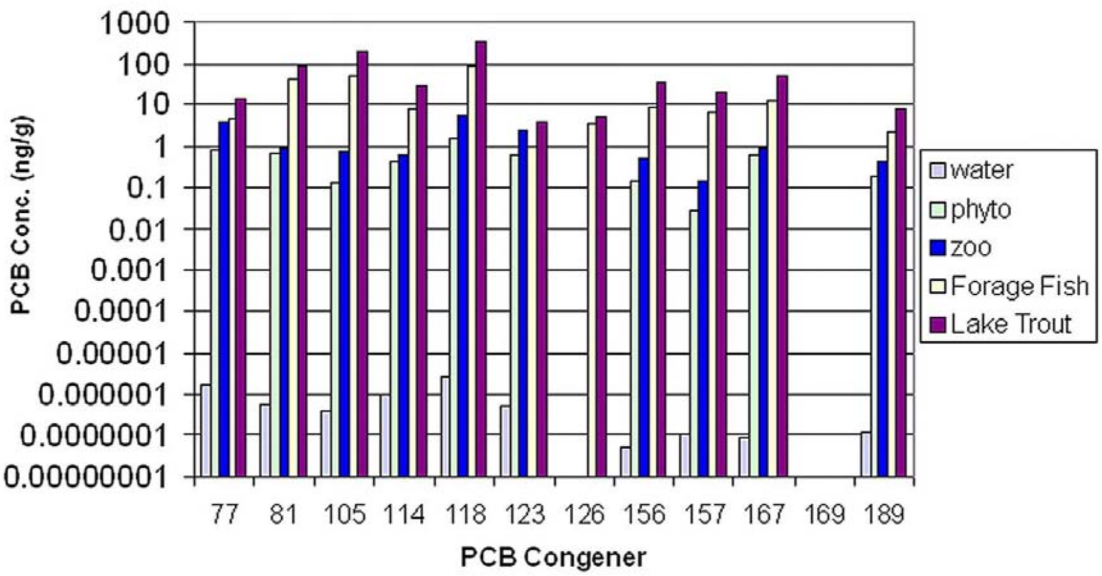
Fish samples from the LMMB Study were analyzed for 80 individual PCB congeners including all of the toxic congeners except for PCB 169. Sediment, tributary, water column, and plankton samples were not analyzed for PCB 169 or PCB 126. In the Lake Michigan food web, the toxic PCB congeners bioaccumulated and biomagnified in the same general pattern as described for total PCBs. Concentrations of these toxic PCB concentrations increased in each successive trophic level

Table 9-2. Toxic PCB Congeners and Toxicity Equivalency Factors (TEF)

PCB Congener	TEF
77	0.0001
81	0.0001
105	0.0001
114	0.0005
118	0.0001
123	0.0001
126	0.1
156	0.0005
157	0.0005
167	0.00001
169	0.01
189	0.0001

of the Lake Michigan food web (Figure 9-9). Of the toxic PCB congeners, concentrations of PCB 118 were highest. This congener has a TEF of 0.0001, meaning that the compound is one ten-thousandth as toxic as TCDD. PCB 126, which is the most toxic of the PCB congeners (TEF of 0.1), was found in fish tissue at nearly the lowest level of toxic PCB congeners.

Figure 9-9. Concentration of Toxic PCB Congeners in the Lake Michigan Ecosystem



In open-lake water, the sum of the 12 toxic PCB congeners contributed 3.9% of the total PCB concentration. In the lower pelagic food web (phytoplankton, zooplankton, *Mysis*, and *Diporeia*), the toxic PCB congeners contributed 9.5 to 12% of the total PCB concentration. In fish, the toxic PCB congeners contributed 11 to 19% of the total PCB concentration. The percentage of total PCBs attributed to the toxic congeners did not increase by trophic level. In both phytoplankton (the base of the pelagic food web) and lake trout (the top of the pelagic food web), the toxic PCB congeners contributed 11% of the total PCB concentration. The highest percentage of toxic PCB congeners (19%) was observed in the deepwater sculpin.

In relation to total PCBs, most of the toxic PCB congeners were bioaccumulated to a greater extent (Figure 9-10). The toxicity of these congeners and their potential for bioaccumulating, in part, depends upon their ability to penetrate cell membranes. In phytoplankton, bioaccumulation factors for all of the toxic PCB congeners were higher than for total PCBs. In zooplankton, bioaccumulation factors for all of the toxic PCB congeners except for PCB 114 were higher than for total PCBs. In forage fish and lake trout, bioaccumulation factors for all of the toxic PCB congeners except for PCB 77, 114, and 123 were higher than for total PCBs. This indicates that bioaccumulation based on total PCB values may underestimate the bioaccumulation of the toxic PCB congeners.

The drop in BAFs for PCBs 77 and 123 that is apparent in Figure 9-10 may be an artifact of analytical differences between the laboratories responsible for the analyses of lower pelagic food web organisms and fish. In the lower pelagic food web analyses, PCBs 77 and 123 each coeluted with another PCB congener that is not among the 12 toxic PCBs, while in the fish analyses, these two PCBs did not coelute with any other congeners. Thus, concentrations of PCBs 77 and 123 may be biased high in the phytoplankton and zooplankton samples, leading to higher BAFs for these two trophic levels, while the BAFs for forage fish and trout do not include contributions from other congeners.

Figure 9-10. Bioaccumulation Factors (BAFs) for Toxic PCB Congeners and Total PCBs in Lake Michigan Biota

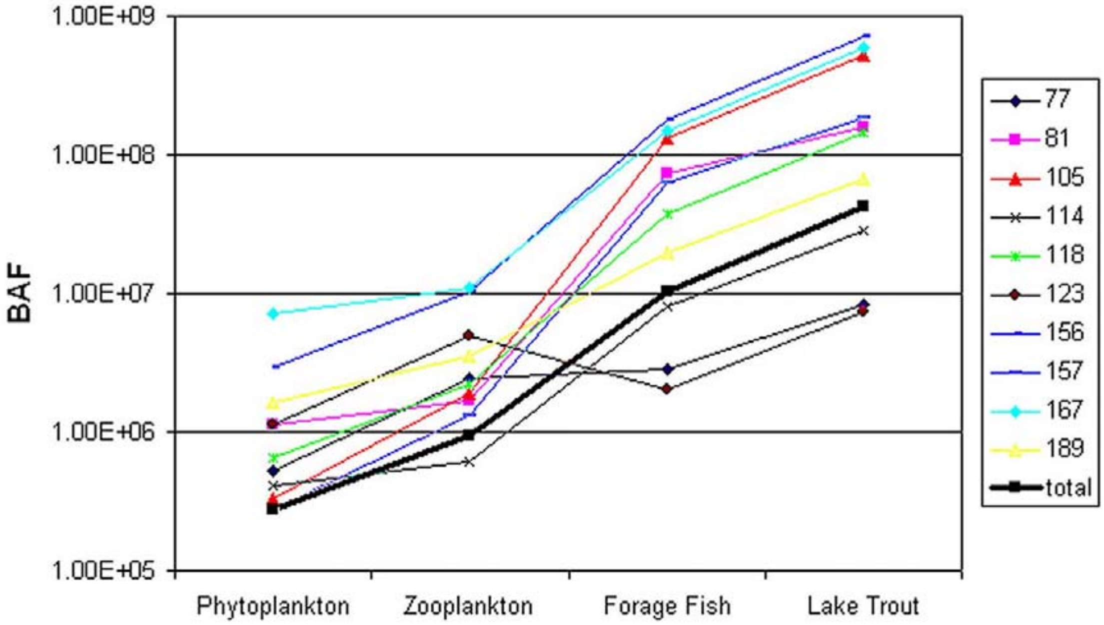


Table 9-3 shows toxic equivalent concentrations (TEQs) calculated for the toxic PCB congeners in terms of TCDD. TEQ values ranged from 0.0032 to 0.52 ng/g - TCDD equivalents. Even though these TEQs include only dioxin-like PCBs and not measured concentrations of dioxins and furans, these values exceed EPA's recommended fish consumption limits for dioxins/furans TEQs of 0.0012 ng/g. It should also be noted that these TEQ values do not include the contribution of PCB 169, because this congener was not analyzed in the LMMB Study.

Table 9-3. Toxic Equivalent Concentrations (TEQs) for Dioxin-like PCB Congeners in Lake Michigan Fish

Species/Size Category	TEQ[a] (ng/g)
Alewife<120mm	0.015
Alewife>120mm	0.075
Bloater<160mm	0.060
Bloater>160mm	0.52
Coho-Adult	0.035
Coho-Hatchery	0.0032
Coho-Yearling	0.010
Deepwater Sculpin	0.048
Lake Trout	0.24
Smelt	0.039
Slimy Sculpin	0.029

[a] TEQ based on toxicity of dioxin-like PCB congeners relative to 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD).

PCB 126, the most toxic PCB congener, contributed 71 to 98% of the total TEQ values for each species, with the exception of coho salmon collected from the hatchery (in which PCB 126 was not detected). Surprisingly, the highest TEQ value was not calculated for lake trout but was calculated for large bloater chub. While total PCB concentrations in lake trout were 3.6 times total PCB concentrations in large bloater chub, concentrations of PCB 126 were higher in large bloater chub (5.1 ng/g) than in lake trout (2.0 ng/g). The higher concentration of this PCB congener in large bloater chub caused the higher TEQ for large bloater chub. This finding also points out the importance of measuring and evaluating individual PCB congener concentrations in addition to total PCB concentrations.